

THE ORB-WEAVER GENUS *ZYGIELLA* (ARANEAE: ARANEIDAE)

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ABSTRACT. The fifteen known species of *Zygiella* are redescribed and illustrated. Eleven are Palearctic, one Holarctic, one Nearctic, one Oriental and one Asiatic. *Zygiella atrica* and *Z. x-notata* are introduced to North America from Europe; *Z. x-notata* has probably been spread by man, especially to temperate South America.

Zygiella differs from *Araneus* in having the eye region more compact and in having characteristic markings on the dorsoventrally flattened, oval abdomen. Also the epigynal scape, when present, is smooth and there is a projection or sculpturing of the male tegulum. *Zygiella* exhibits diverse modifications of the paracymbium; the paracymbium is simple and hook-shaped in *Araneus*. In addition, the web of *Zygiella* has an open sector, whereas that of *Araneus* is complete.

Despite their diverse genitalia, the species of *Zygiella* appear closely related.

A few measurements of differently sized individuals of Japanese *Zygiella sia*, presumably individuals that matured in different instars, indicate that in females growth in leg length is proportional to carapace length, and distance from lateral eyes to median eyes increases at a slightly slower rate than growth of carapace (the eye diameter presumably grows slightly, but less than the carapace). Larger males may have relatively longer legs. There were hardly any differences in size of the genitalia.

INTRODUCTION

Spiders of the families Aranidae and Linyphiidae have far more complicated genitalia than spiders of other families. The temptation is to use these excellent species-separating characters to group the species into genera. That generic grouping has been a problem is well-known. Simon, perhaps the foremost 19th century arachnologist, synonymized most araneid genera in *Araneus* (1895). I believe this was an action of despair by a specialist who minimized the importance of genitalia. On the other hand, Archer (1951a, b) more recently grouped the species into genera mainly on the basis of the shape of the median apophysis, one of numerous sclerites in the male palpus. Neither extreme is satisfactory.

The difficulty of using only genitalia in separating genera is perhaps best demonstrated in *Mangora* (Levi, in preparation). The high thorax and the feathered trichobothria, a sense organ on the third tibia, make it easy to separate *Mangora* species on first inspection from species belonging to other genera. The genitalia of the numerous species show great diversity. All indications are that the body shape and sense organs reflect close relationship of the many species and that it is a monophyletic group despite the variability in the genitalia.

But are there other aranid genera whose species, while readily recognized as belonging together, show diversity in geni-

talia? *Zygiella* species, most of which are Palearctic, have females with and without an epigynal scape; males with and without a palpal terminal apophysis. Despite this it seems that the species included in *Zygiella* are closely related. They are easily recognized by their body shape as belonging to *Zygiella*, even though it is not easy to characterize those features that make them distinct. Also the different species make a similar web with a vacant sector. And when the seemingly diverse genitalia are carefully studied, similarities are found that separate the species from those of other genera.

Modern araneologists subscribe to widely differing concepts of what is a genus, Europeans more than Americans tending to fragment genera in the interest of showing relationships, though the result is just the opposite. They forget the usefulness to themselves in having all oak trees in the genus *Quercus*, all pines in *Pinus*, and forget that araneologists who study taxonomy produce knowledge used by colleagues in fields other than spider taxonomy.

As the American species of *Zygiella* have recently been revised by Gertsch (1964), an attempt was made to revise the group world wide. Gertsch's illustrations do not show the palpal sclerites sufficiently distinctly. (This may be a subjective opinion, just because I did not illustrate them myself.) Some Asian species that have never been illustrated before add new dimensions to the interesting problem of genitalic differences in related species. I did not describe new species, partly because I do not like to describe new forms but also because I suspect that additional *Zygiella* species already described may be misplaced in wrong genera and families. Because I was not describing new species, I did not make an attempt to borrow large unsorted collections of *Zygiella* from other institutions.

Because of the difficulties in visiting European museums and in borrowing type specimens of both previously described

American species and those from other parts of the world, I have to thank many curators and colleagues for their help in making this study possible; as I know from my own experience as curator, it is very time-consuming to locate obscure specimens in the large collections. I wish to thank A. Timothea da Costa of the Museu Nacional, Rio de Janeiro; M. Grasshoff, Senckenberg Museum, Frankfurt; J. Gruber, Naturhistorisches Museum, Vienna; M. Hubert of the Muséum National d'Histoire Naturelle, Paris; C. E. O'Riordan, National Museum of Ireland, Dublin; F. H. Rindge and N. Platnick of the American Museum of Natural History; J. O. Hüsing and R. Piechocki of the Martin Luther Universität of Halle (Saale) of the German Democratic Republic; J. Prószyński and W. Staręga of the Institute of Zoology, Polska Akademia Nauk, Warszawa; G. Schmidt; E. Tortonese of the Museo Civico de Storia Naturale, Genova; G. C. Varley and H. Taylor of the Hope Department of Entomology, Oxford; F. Wanless and D. Norman of the British Museum (Natural History); and T. Yaginuma. D. McGrath and D. McGrath, Jr. were helpful in obtaining specimens. Lorna R. Levi and Ian R. Mackay edited the paper and made helpful comments. The research and publication was in part supported by National Science Foundation research grant GB-36161.

Zygiella F.O. Pickard-Cambridge

Zygia C. L. Koch, 1834, in Panzer, Deutschlands Insekten, Heft 123, 17-19. The type species is *Araneus calophylla* Walckenaer 1802 (? = *x-notata* Clerck) as the only included species. Name *Zygia* preoccupied by Fabricius 1775 for an insect.

Zygiella F. O. Pickard-Cambridge, 1902. Ann. Mag. Natur. Hist. (7)9: 15. New genus "to replace *Zygia* with *Z. atrica* (C. L. Koch) as the type species," as indicated by original designation. The name is of feminine gender.

Description. *Zygiella*, unlike *Araneus*, has the eye region compact, with the eyes closely spaced. The median ocular area



Plate 1. Female *Zygella atrica* (C. L. Koch) from Nahant, Massachusetts, in the laboratory.

is as long as wide in front, always slightly narrower behind than in front (Figures 1, 12, 57, 65). The anterior eyes are about equally spaced. But in larger specimens (*Z. sia*) they are separated as much as two times their diameter from laterals. The posterior median eyes are only about one and one-half times the distance of the median eye interval from the lateral eyes (to almost 5 times in large specimens of *Z. sia*). The carapace is always considerably wider than the eye region in the eye area, at least in females (Figures 1, 12). The anterior median eyes are larger to much larger than the others. Because eye distance increases almost proportionally with length (see below), the eyes of only the smallest *Araneus* species are closely spaced.

The chelicerae have three to four teeth

on the anterior margin, about as many on the posterior, and denticles in the groove between (Figure 58).

The carapace, in contrast to that of *Araneus*, is glabrous brown with very few hairs. The head region is often darker than the thorax. The abdomen, unlike that of *Araneus*, is oval, widest in the middle, dorsoventrally flattened, as in species of *Nuctenea*, but differs from these by being mainly black and white, not brownish (in living as well as in preserved animals). The dorsal folium is almost symmetrical anterior to posterior, widest in middle; the cardiac area, however, generally has a white area while the posterior end of the folium is darkest (Plate 1; Figures 1, 12, 26, 70, 84, 92, 95). There may be a median longitudinal line through the white cardiac spot (Figure 103). The pattern resembles

that of the theridiid genus *Enoplognatha*, but not of other araneids. The venter has a white longitudinal line on each side enclosing a median black or pigmentless area between genital furrow and spinnerets (Figure 27). The epigynum is variable with a posterior median depression (Figures 3, 24, 35) or a scape which is not wrinkled as is the *Araneus* epigynal scape (with few exceptions) (Figures 71, 89, 93, 97, 104, 112). The palpus can be readily distinguished from an *Araneus* palpus by the modified diverse paracymbium (Figures 7, 13, 20, 30, 42, 56, 68, 86, 101, 110, 120). But unlike most Araneidae the palpus has the tegulum often "vertical" in the palpus, the long axis parallel to the long axis of the cymbium (Figures 14, 28, 41, 85), and the tegulum bears unique projections (Figures 42, 56, 60, 68, 75, 85, 118) or sculpturing (Figure 100). A terminal apophysis may be present in some species (Figures 40, 60), but not in *Zygiella atrica*, *Z. keyserlingi*, *Z. x-notata*, and *Z. minima* (Figures 7, 30).

The male palpal femur lacks the proximal ventral tooth present in *Araneus*. The male palpal patella usually has only one seta in *Zygiella*, two in *Araneus*. However, *Zygiella sia* may have one or two. The first coxa does not have a hook and the tibiae of the first two legs of the male are not modified. The first patella-tibia of the female is about 1.2–1.5 carapace lengths, that of the male 1.5–2.0.

Zygiella differs from *Meta*, which also has a modified paracymbium, in having more complex genitalia (the sculptured tegulum and complex median apophysis). I suspect the genera are related.

Most *Zygiella* webs have a vacant sector on the upper half in the direction of the retreat, but sometimes complete webs are made.

Zygiella species have been confused with species of *Enoplognatha* and *Steatoda*, both Theridiidae. *Steatoda*'s abdomen is usually purplish brown while that of *Zygiella* is black and white. The male *Eno-*

plognatha palpus is of very characteristic shape, having only a minute paracymbial hook on the lateral edge of the cymbium, some distance from the tibia. *Enoplognatha* and *Zygiella* females are difficult to separate on first impression, but female *Zygiella* have three to four teeth on the posterior margin of the chelicerae and denticles between the two rows of teeth (Figure 58), while *Enoplognatha* females have only one or two teeth on the posterior cheliceral margin and lack the denticles in the groove.

Very few specimens were available for most species examined here. No attempt was made to borrow the hundreds of specimens that are usually available for studies of American species. It would have been impossible to obtain large series even if I had tried.

The vast difference in sizes of the few Japanese *Zygiella sia* available indicates a taxonomic problem easily overlooked (see under *Z. sia* below). The larger the araneid spider, the farther apart the eyes. The growth in distance between median and lateral eyes is almost proportional to growth of carapace width. A careful study of proportional or allometric growth of structures used as taxonomic features in the family may be worthwhile.

The following species described or placed in *Zygiella* do not belong to it or the types are lost.

alpina, *Zilla*, Giebel, 1867. *Zeitschr. gesammt. Naturwissenschaft.*, 30: 434. Female holotype from La Flegère, Chamonix Valley, Switzerland [? sic] in the Zoology Dept. of the Martin Luther Universität, Halle, German Democratic Republic (examined). = *Theridion sisypnum* (Clerck). NEW SNONYMITY.

ancora, *Epeira*, Krynicki, 1837. *Bull. Soc. Imp. Natur. Moscow*, 5: 81 from Russia is *Steatoda bipunctata* according to Roewer (1955, *Katalog der Araneae*, 26: 1477).

aureola, *Zilla*, Keyserling, 1884. *Verhandl. zool. bot. Ges. Wien*, 33: 652, pl. 21, fig. 4, ♀ from the Amazon in the Muséum National d'Histoire Naturelle, Paris, is a species close to *Meta*. The type had been marked "*Meta aureola* Keys." by Simon.

calophylla, Arauca, Walckenaer, 1802, Faune Parisienne, 2: 200, doubtful name. Roewer (1942) considers it to be a senior synonym of *Z. atrica* (C. L. Koch), Bonnet (1959) a junior synonym of *Z. x-notata*. For purposes of nomenclatural stability the synonymy of Bonnet should be followed.

crucinotata, *Zilla*, Pokrovskii, 1904. Zap. Imp. Roussk. Geogr. Obshch., 41: 300, fig. 25, 25a is not recognizable, but almost certainly is an *Enoplognatha*. The author compares it with another *Enoplognatha* species.

decolorata, *Zilla*, Keyserling, 1893. Spinnen Amerikas, 4: 306, pl. 15, fig. 226, ♀. Male holotype from Brazil (examined) is a *Mangora*.

gigans, *Zilla*, Franganillo, 1913. Broteria, 11: 128. Not recognizable.

guttata, *Zilla*, Keyserling, 1880. Verhandl. zool. bot. Ges. Wien, 30: 551, pl. 16, fig. 3, ♀. Female holotype from Peru (examined) is a *Leucange*.

guyaneensis, *Zilla*, Keyserling, 1880. Verhandl. zool. bot. Ges. Wien, 30: 554, pl. 16, fig. 5, ♂. Male type from Guyana (examined) is of an unknown genus, not *Zygiella*.

melanocephala, *Linyphia*, Taczanowski, 1874. Hor. Soc. Ent. Rossiae 10: 70. Types from Guyana (examined) are *Mangora*.

nawazi, *Zilla*, Dyal, 1935. Bull. Dept. Zool. Panjab Univ., 1: 186, pl. 11, fig. 6, pl. 16, fig. 124 from India is an *Araneus* judging by the illustrations.

punctata, *Zilla*, Keyserling, 1893. Spinnen Amerikas, 4: 305, pl. 15, fig. 225, ♀. Female type from Brazil, lost.

rogenhoferi, *Zilla*, Keyserling, 1877. Verhandl. zool. bot. Ges. Wien 27: 578, pl. 14, fig. 6, ♀. Female holotype from Brazil (examined) is a *Metazygia*.

KEY TO MALES OF *ZYGIELLA* SPECIES

(Males of *Z. calyptata*, *Z. inconveniens* and *Z. melauocraua* are not known.)

| | | |
|--------|--|--------------------|
| 1 | Palpal tibia much longer than cymbium (Figs. 5, 13) | 2 |
| - | Palpal tibia of same length or shorter than cymbium | 3 |
| 2(1) | Palpal tibia with a distal bulge (Fig. 13); paracymbium pointed at tip (Fig. 13); median apophysis with two long spines (Fig. 14); Europe | <i>keyserlingi</i> |
| - | Palpal tibia with sides parallel (Fig. 5); paracymbium rounded at tip (Fig. 5); median apophysis with short spines (Fig. 6); North America and Europe | <i>atrica</i> |
| 3(1) | Tegulum of palpus without projection (other than conductor) (Figs. 28, 29); cosmopolitan | <i>x-notata</i> |
| - | Tegulum of palpus with a projection or sculpturing (other than conductor) (Figs. 42, 56, 68) | 4 |
| 4(3) | Tegulum in "horizontal" position in cymbium, its long axis transverse to that of cymbium (Fig. 119); projection with teeth "vertical" and surrounding conductor (Fig. 119); paracymbium a hook, barely modified (Figs. 118-120); Japan | <i>asia</i> |
| - | Tegulum in more or less "vertical" position in cymbium, its long axis parallel to cymbium (Fig. 100); projection not vertical | 5 |
| 5(4) | Tegulum projection in ventral view in the shape of a human ear (Fig. 100); paracymbium square (Fig. 101) | <i>thorelli</i> |
| - | Tegulum with simple projection; paracymbium not a square (Figs. 68, 75) | 6 |
| 6(5) | In lateral view tegulum projection almost as long or longer than tegulum width (Figs. 68, 110) | 7 |
| - | In lateral view tegulum projection shorter than width of tegulum (Figs. 75, 86) | 8 |
| 7(6) | Tegulum projection pointed (Fig. 68); paracymbium with a dorsally directed point (Fig. 68); California | <i>carpenteri</i> |
| - | Tegulum projection truncate (Fig. 109); paracymbium a ventrally directed lobe (Fig. 110); Europe | <i>stroemi</i> |
| 8(6) | Palpus with a sclerite (? terminal apophysis) more or less parallel to embolus (in ventral view) in distal part of palpus (Figs. 41, 55); paracymbium complex with a notch (Figs. 47-49, 59) | 9 |
| - | Palpus with no sclerite parallel to embolus (in ventral view) (Figs. 19, 74, 85); paracymbium without notch (Figs. 20, 75, 86) | 10 |
| 9(8) | A sclerite (? terminal apophysis) longer than embolus in ventral view (Fig. 41); paracymbium with a distal notch (Figs. 47-49); eastern Asia, North America | <i>dispar</i> |
| - | Terminal apophysis shorter than embolus in ventral view (Fig. 55); paracymbium with a ventral notch (Fig. 59); Europe | <i>montana</i> |
| 10(8) | Base of conductor sitting in a depression surrounded by a rim, or base of conductor surrounded by wrinkles (Figs. 75, 85); Eurasia | 11 |
| - | Base of conductor not surrounded by wrinkles or a rim (Fig. 19); Canary Isl. | <i>minima</i> |
| 11(10) | Base of conductor in a depression surrounded by a rim (Fig. 85) | <i>kochi</i> |

— Base of conductor surrounded only by wrinkles of the tegulum (Figs. 74, 75) *caspica*

KEY TO FEMALES OF *ZYGIELLA* SPECIES

1 Posterior rim of epigynum with a semi-circular lobe (Fig. 71) *caspica*
 — Posterior rim otherwise 2

2(1) Epigynum with a scape (Figs. 89, 93, 97, 104, 112) 3
 — Epigynum without a scape (Figs. 3, 10, 16, 22, 34, 77, 82) 7

3(2) Openings ventral underneath heart-shaped scape (Fig. 112); Japan *sia*
 — Openings posterior 4

4(3) Scape constricted at base (Figs. 89, 93) 5
 — Scape not constricted at base (Figs. 97, 104) 6

5(4) Scape heart-shaped, slightly longer than wide (Fig. 89) *kochi*
 — Scape more than twice as long as wide (Fig. 93); Palestine *inconveniens*

6(4) Scape a broad lobe with a posterior median extension (Fig. 97) *thorelli*
 — Scape much longer than wide with parallel sides (Fig. 104) *stroemi*

7(2) No depression, openings or sculpturing visible in ventral view of epigynum, at most a posterior rim (Figs. 16, 22); posterior view with two separate openings (Figs. 18, 24) 8
 — In ventral view a depression, openings or sculpturing visible (Figs. 3, 10, 34, 77, 82); no distinct pair of openings in posterior view 9

8(7) Total length more than 4 mm; epigynum heavily sclerotized (Figs. 22, 24); probably cosmopolitan *x-notata*
 — Total length less than 3.5 mm; epigynum lightly sclerotized (Figs. 16, 18); Canary Isl. *minima*

9(7) Semicircular openings bordered on venter of epigynum (Fig. 82); Burma *melanocrania*
 — Openings not so; venter of epigynum with a median depression or bulge (Figs. 3, 10, 34, 77) 10

10(9) A median, posterior, indistinctly bordered, dark depression in ventral view of epigynum (Fig. 77); fourth coxae drawn out posteriorly into a spine (Fig. 80); Malaysia *calyprata*
 — Posterior depression or bulge distinctly bordered (Figs. 3, 10, 34); fourth coxae without a spine; Holarctic region 11

11(10) Median area of epigynum a depression in ventral view much wider than long (Fig. 63); California *carpenteri*
 — Median area at most one and one half times as wide as long (Figs. 3, 10, 34) 12

12(11) Median area of epigynum a bulging lobe framed anteriorly only by a lip (Fig. 10); Europe *keyserlingi*
 — Median area depressed, framed anteriorly and laterally (Figs. 3, 34, 52) 13

13(12) Median depressed area extending posteriorly in ventral view (Fig. 3); in posterior view sides of epigynum lightly sclerotized and smaller than median depression (Fig. 4); Europe, North America *africana*
 — Median depressed area not projecting beyond sclerotized area of epigynum in ventral view (Figs. 34, 38, 52); in posterior view sides of epigynum heavily sclerotized and sclerotized areas larger in area than median depression (Figs. 35, 39, 54) 14

14(13) Median area with a constriction as seen in both ventral and posterior views (Figs. 34, 35, 38, 39); Eastern Asia, North America *dispar*
 — Median area without constriction as seen in both ventral and posterior views (Figs. 52, 54); Europe *montana*

***Zygiella atrica* (C. L. Koch)**
Plate 1; Figures 1-8

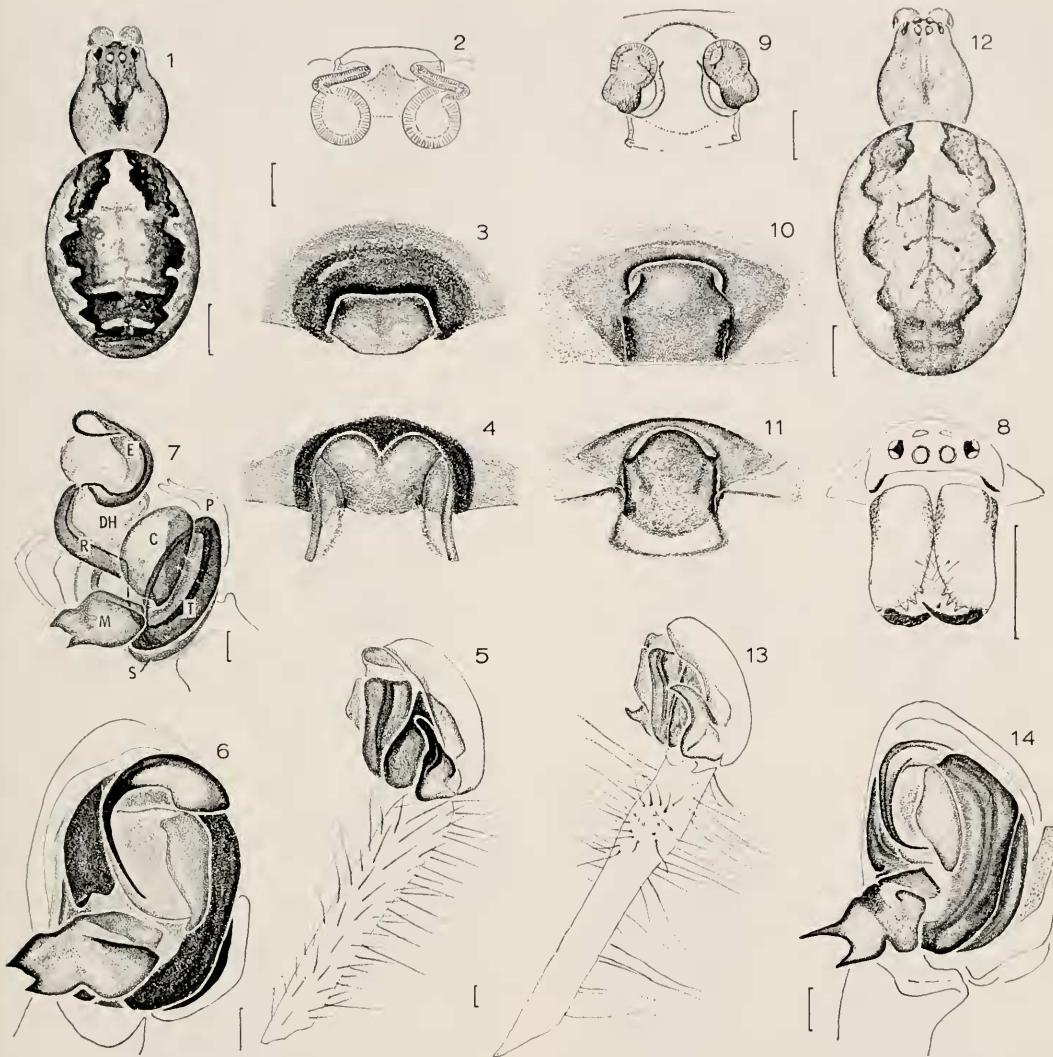
Eucharia atrica C. L. Koch, 1843, Die Arachniden, 12: 103, figs. 1030, 1031, ♀, ♂. Specimens came from Germany and France and are presumably in the museum of the Humboldt Universität, Berlin.

Zilla atrica, - Wiegke, 1931, Tierwelt Deutschlands, 23: 33, figs. 38-40, ♀, ♂.

Zygiella atrica, - Bonnet, 1959, Bibliographia Aranearium, 2: 4998. Gertsch, 1964, Amer. Mus. Novitates, No. 2188: 16, figs. 18-20, ♂, ♀.

Diagnosis. This species can be confused only with *Z. keyserlingi*. The male differs from other *Zygiella* by the long palpal tibia and, unlike that of *Z. keyserlingi*, the tibia has its sides parallel (Figure 5) with setae equally distributed. The epigynum has a wide median lobe extending posteriorly in ventral view; the lobe is depressed in the middle and the lateral sclerotized areas are relatively small (Figures 3, 4).

Natural history. This species is common-



Figures 1-8. *Zygella atrica* (C. L. Koch). 1. Female. 2-4. Epigynum. 2. Posterodorsal view, cleared. 3. Ventral. 4. Posterior. 5-7. Left male palpus. 5. Lateral view. 6. Ventral. 7. Expanded. 8. Eye region and chelicerae of female.

Figures 9-14. *Z. keyserlingi* (Ausserer). 9-11. Epigynum. 9. Dorsal, cleared. 10. Ventral. 11. Posterior. 12. Female. 13-14. Male palpus. 13. Lateral. 14. Ventral.

Abbreviations. C, conductor; DH, distal hematodocha; E, embolus; M, median apophysis; P, paracymbium; R, radix; S, subtegulum; T, tegulum.

Size lines. 0.1 mm, except Figures 1, 8, 12, 1 mm.

est on ocean coasts, but is found in Europe also in other locations (Wiehle, 1931), on shrubs, junipers, etc. In America the species is certainly introduced and is found

in coastal areas of the ocean and of Lake Erie. On the peninsula of Nahant, Massachusetts, it is very common under and between boulders placed to prevent the road

from being washed away by high tides. As it can be found abundantly among these boulders year after year, the species can presumably tolerate the occasional high waves and salt spray from the ocean. Adult males and females have been found in this location in October.

The web (Wiehle, 1931) has more radii (43–50) than that of *Z. x-notata* and many other orb-weavers; most radii are in the lower half of the web. The free sector is narrow and the hub has a fine mesh. There are many frame threads, many close to the spiral region. The retreat is not as well built as that of *Z. x-notata*. Emerton's picture of the web (1902, *The Common Spiders of the United States*) shows only a few radii.

Distribution. Europe; in America from Nova Scotia to Long Island, New York; Port Credit, Ontario, and British Columbia coast. For map see Gertsch (1964).

Zygiella keyserlingi (Ausserer)

Figures 9–14

Zilla keyserlingi Ausserer, 1871, Verhandl. zool. bot. Ges. Wien, 21: 830, pl. 5, fig. 11, ♀. Female holotype from Dalmatia in the Keyserling collection of the British Museum, Natural History, not examined. Wiehle, 1931, Tierwelt Deutschlands, 23: 35, figs. 41, 42, ♀, ♂.

Zygiella keyserlingi, - Roewer, 1942, Katalog der Araneae, 1: 884. Bonnet, 1959, Bibliographia Araneariorum, 2: 5002.

Description. Female from unknown locality in Europe. Carapace light brown, cephalic region not much darker. Legs not banded. Dorsum of abdomen with characteristic pattern (Figure 12) and venter with a white line on each side. Diameter of posterior median eyes 0.9 diameter of anterior medians, anterior laterals 0.8, posterior laterals 0.7 diameter of anterior median eyes. Anterior median eyes one diameter apart, one from laterals. Posterior median eyes one diameter apart, 1.5 from laterals. There are three teeth on the anterior margin of the chelicerae, three on the posterior, with denticles between the

margins. Total length 8.0 mm. Carapace 2.7 mm long, 2.3 mm wide. First femur, 3.1 mm; patella and tibia, 4.0 mm; metatarsus, 3.1 mm; tarsus, 1.0 mm. Second patella and tibia, 2.9 mm; third, 1.7 mm; fourth, 2.6 mm.

Male from unknown locality. Coloration like that of female. Diameter of posterior median eyes and of anterior lateral eyes 0.7 diameter of anterior median eyes; that of posterior lateral eyes 0.6 diameter of anterior medians. Anterior median eyes slightly less than their diameter apart, and slightly less than their diameter from laterals. Posterior median eyes slightly less than one diameter apart, 1.5 diameters from laterals. Total length 6 mm. Carapace 2.9 mm long, 2.0 mm wide. First femur, 4.1 mm. Second patella and tibia, 3.6 mm; third, 2.0 mm; fourth, 2.9 mm.

Additional female and male specimens were available from Krivosije, Dalmatia.

Diagnosis. The long palpal tibia is found also in *Z. atrica*; however, *Z. keyserlingi* has the tibia distally swollen with the swollen area having more setae than the basal part (Fig. 13). The epigynum has a central bulging area bordered anteriorly only by a transverse lip (Figures 10, 11). The species is less pigmented than *Z. atrica*.

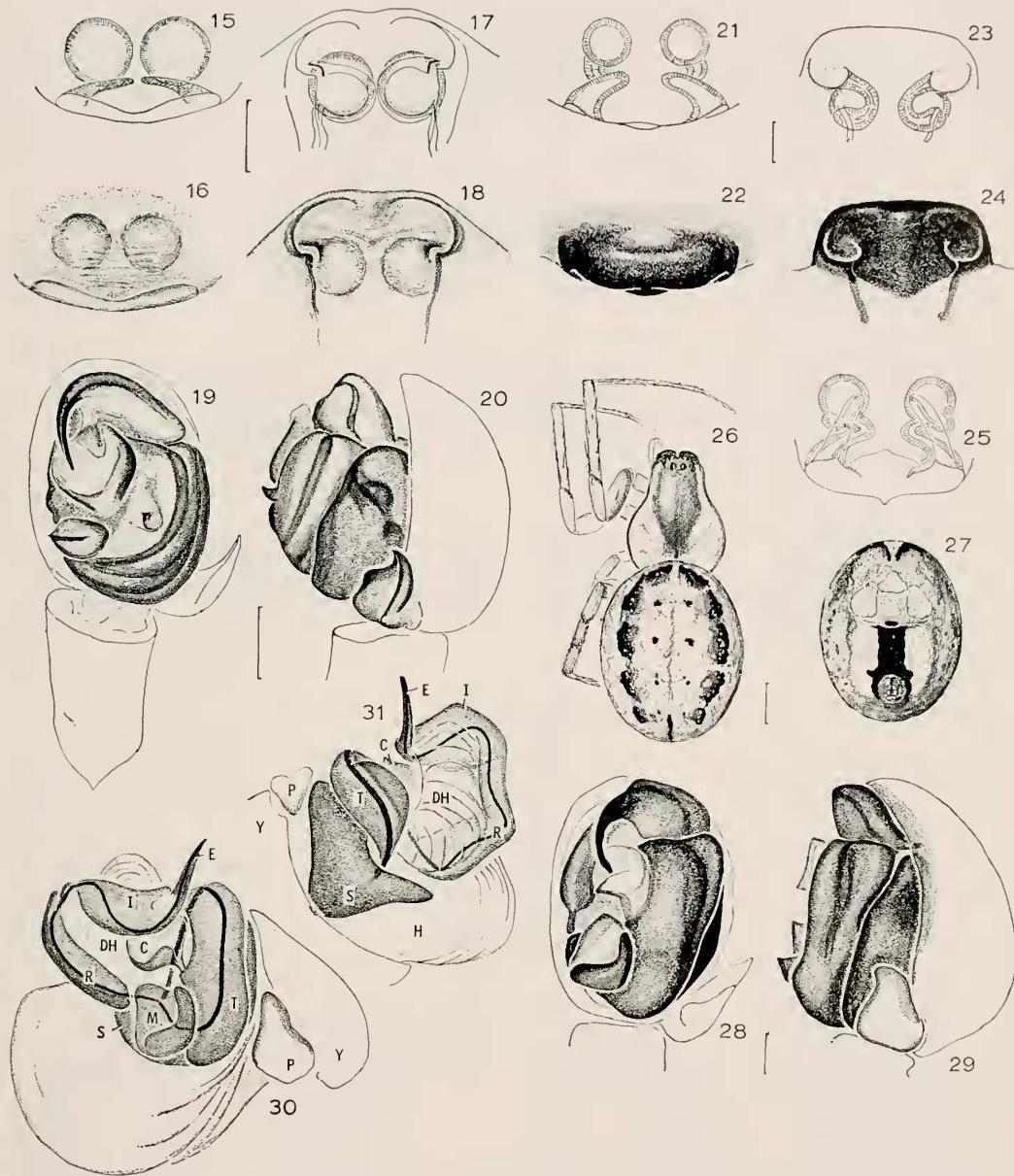
Distribution. Portugal, Italy, Hungary to Greece (Bonnet, 1959).

Zygiella minima (Schmidt)

Figures 15–20

Zygiella x-notata minima Schmidt, 1968, Zool. Beitr., 14: 414, fig. 11, ♂. Female, male syntypes in poor physical condition from Esperanza Forest, Tenerife, Canary Islands, owned by the author G. Schmidt, but made available to me.

Description. Female. Coloration difficult to determine. Eyes seem about subequal in size. The anterior median eyes slightly less than their diameter apart, their radius from laterals. Posterior median eyes their radius apart, about 0.8 diameter from laterals. Total length 3 mm. Carap-



Figures 15-20. *Zygiella minima* (Schmidt). 15-18. Epigynum. 15. Ventral, cleared. 16. Ventral. 17. Posterior, cleared. 18. Posterior. 19-20. Left male palpus. 19. Ventral. 20. Lateral.

Figures 21-31. *Z. x-notata* (Clerck). 21-25. Epigynum. 21. Ventral, cleared. 22. Ventral. 23. Posterior, cleared. 24. Posterior. 25. Dorsal, cleared. 26. Female. 27. Female abdomen, ventral. 28-31. Male palpus. 28. Ventral. 29. Lateral. 30, 31. Expanded. 30. Subventral view of bulb. 31. Dorsal view of bulb.

Abbreviations. C, conductor; DH, distal hematodocha; E, embolus; I, stipes; M, median apophysis; P, paracymbium; R, radix; T, tegulum; Y, cymbium.

Size lines. 0.1 mm except Figures 26, 27, 1 mm.

pace 1.5 mm long. First femur, 2.0 mm; patella and tibia, 2.4 mm; metatarsus, 1.8 mm; tarsus, 0.7 mm. Second patella and tibia, 1.7 mm; third, 1.0 mm; fourth, 1.6 mm.

Male. In slightly better physical condition than female. Eyes subequal in size. Anterior median eyes their diameter apart, 0.8 diameter from laterals. Posterior median eyes slightly less than their diameter apart, their diameter from laterals. Total length 2.5 mm. Carapace 1.2 mm long, 0.9 mm wide. First femur, 1.6 mm; patella and tibia, 2.1 mm; metatarsus, 1.6 mm; tarsus, 0.7 mm. Second patella and tibia, 1.5 mm; third, 0.8 mm; fourth, 1.2 mm.

Diagnosis. *Zygiella minima* differs from *Z. x-notata* in that the female has the epigynum lightly sclerotized and with differently sized openings in posterior view (Figures 16, 18); the male has a small tooth-shaped projection on the face of the tegulum (Figures 19, 20) absent in *Z. x-notata*.

Distribution. Canary Islands.

Zygiella x-notata (Clerck)

Figures 21–31, 57–58

Araneus x-notatus Clerck, 1758, Aranei Svecici, 46, pl. 2, fig. 5. A Clerck specimen bearing this name as labeled by Thorell is in the Swedish Museum of Natural History, Stockholm; not examined.

Zilla bösenbergi Keyserling, 1878, Verhandl. zool. bot. Ges. Wien, 28; 575, pl. 14, fig. 4, 5, ♀, ♂. Female and male syntypes from Uruguay in the museum of the University of Hamburg and the British Museum (Natural History), examined. NEW SYNONYMY.

Zilla californica Banks, 1896, J. New York Ent. Soc., 4: 90. Female holotype from Palo Alto, California, in the Museum of Comparative Zoology, examined. Gertsch (in letter, 1957) indicated that Stanford University Museum had specimens marked types. This spider collection has since been sent to the Los Angeles County Museum and was destroyed (C. L. Hogue, personal communication).

Larinia maulliana Mello-Leitão, 1951, Rev. Chilena Hist. Natur., 51–53: 331, figs. 5, 6, ♂. Male holotype from Maullín, Chile, in the Museu Nacional, Rio de Janeiro, examined. NEW SYNONYMY.

Zygiella x-notata, - Bonnet, 1959, Bibliographia Aranearium, 2: 5007. Gertsch, 1964, Amer. Mus. Novitates, No. 2188, 12, figs. 2, 15–17, ♀, ♂, map.

Diagnosis. The epigynum, unlike that of *Z. minima*, is heavily sclerotized. It has two diagnostic openings seen in posterior view (Figure 24). The palpus is simple with the tegulum's long axis parallel to that of the cymbium (Figures 28–30); the lack of terminal apophysis (Figures 30, 31) separates males from those of other species, the lack of a tegulum projection from males of *Z. minima*.

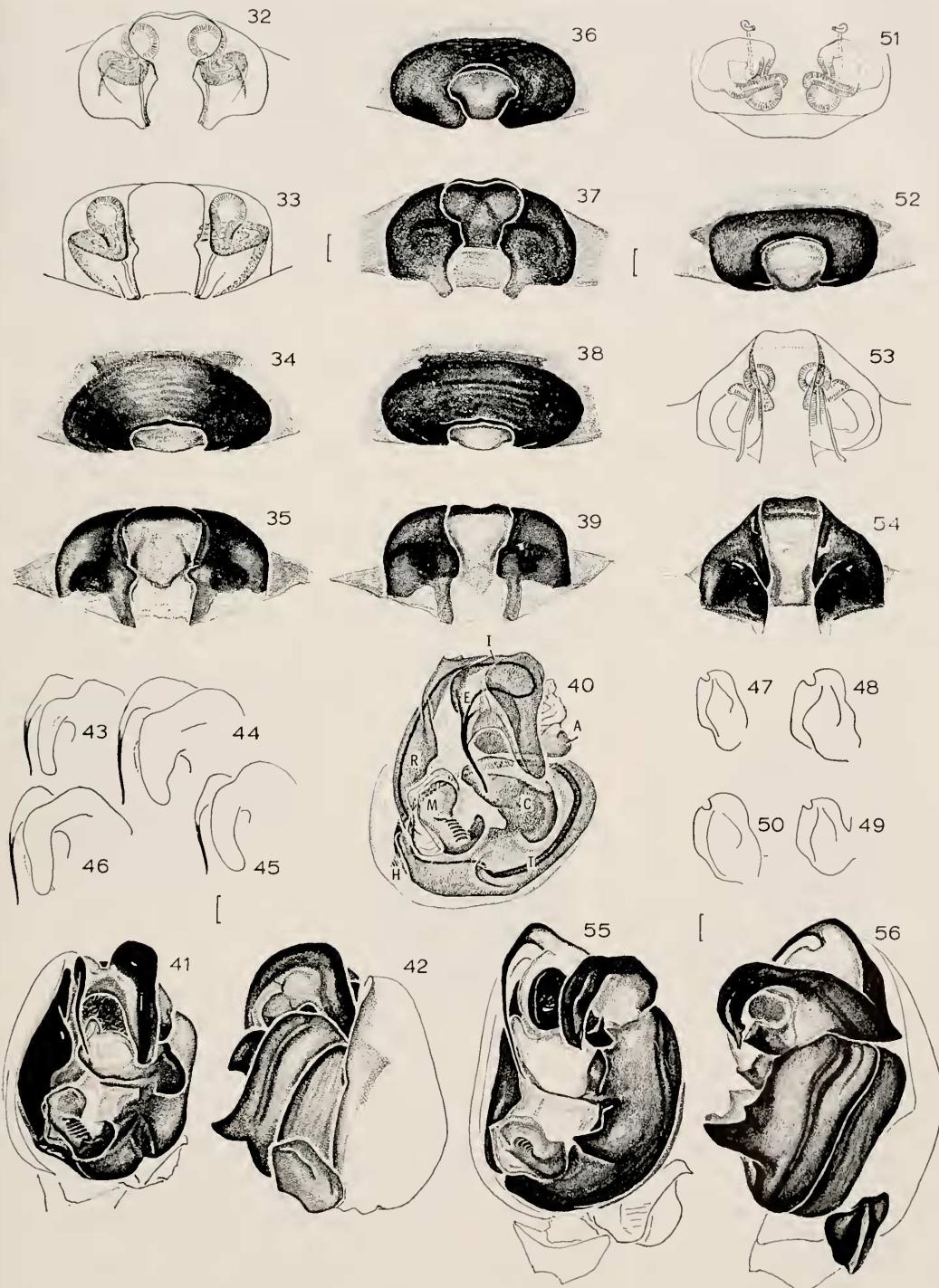
Natural history. Numerous references to habits and webs can be found in Bonnet (1959). The web, which has a vacant sector, has been used in ethological studies. It is illustrated in Wiehle (1931), figure 37, and J. Comstock, 1940, The Spider Book, figure 470. The species is very common in southern Chile. In the city park of Osorno, Chile, I found suspended from a web on a telephone pole a dried, shrivelled, 6-cm long lizard on which a *Z. x-notata* had apparently fed (15 March 1965).

Figures 32–50. *Zygiella dispar* (Kulczynski). 32–39. Epigynum. 32, 33. Posterior view, cleared. 34, 36, 38. Ventral. 35, 37, 39. Posterior. 32. (Michigan). 33–35. (Mendocino Co., California). 36, 37. British Columbia. 38, 39. (Virginia). 40–50. Left male palpus. 40. Expanded. 41. Ventral. 42. Lateral. 43–46. Embolus and apophysis. 43. (Alaska). 44. (California). 45. (Manitoba). 46. (Maine). 47–49. Paracymbium. 47. (Alaska). 48. (California). 49. (Manitoba). 50. (Maine).

Figures 51–56. *Zygiella montana* (C. L. Koch). 51–54. Epigynum. 51. Anterodorsal view, cleared. 52. Ventral. 53. Posterior, cleared. 54. Posterior. 55, 56. Male palpus. 55. Ventral. 56. Lateral.

Abbreviations. A, terminal apophysis; C, conductor; E, embolus; H, hematodocha; I, stipes; M, median apophysis; T, tegulum.

Scale lines. 0.1 mm.



Adult males are found from July until September on the Pacific coast of North America.

Distribution. Europe, but probably cosmopolitan, carried around the world by man. It is introduced in America and found along the Atlantic coast from Maine to Virginia, the Pacific coast from southern British Columbia to southern California. Gertsch (1964) maps the North American distribution. It is very common in Chile and is found in Uruguay and Argentina.

Zygiella dispar (Kulczyński)

Figures 32-50

Zilla dispar Kulczyński, 1885, *Denkschrift. Akad. Wissenschaften Krakow*, 11: 24, pl. 9, fig. 7, ♀, ♂. Male type from Kamtchatka, Siberia, in Polish Academy of Sciences, Warsaw, in poor physical condition, examined.

Zygiella moutana, - numerous authors of American records only.

Zygiella dispar, - Gertsch, 1964, *Amer. Mus. Novitates*, No. 2188: 7, figs. 7-10, ♀, ♂.

Zygiella nearctica Gertsch, 1964, *Amer. Mus. Novitates*, No. 2188: 4, figs. 3-6, ♀, ♂. Male holotype from Seba, Alberta, in the American Museum of Natural History, not examined. NEW SYNONYMY.

Note. Gertsch (1964) used the name *dispar* for the population along the Pacific coast from Alaska to south-central California; other specimens he called *nearctica*. Gertsch separated *Z. nearctica* from *Z. dispar* by the following characters: the male palpus has the apical [= ? subterminal] apophysis less developed, and has "differences of the various apophysis"; the female epigynum has the "fovea" visible from below. The last character is a matter of position of the epigynum during examination. Gertsch's figure 7 (*dispar*) is much more characteristic of all specimens of the species in ventral view than is figure 4 (*nearctica*), which is the view from slightly posterior. The subterminal apophysis differs among individuals (Figures 43-46), as do the paracymbium (Figures 47-50) and, to a lesser extent, the median apophysis (not illustrated). Similarities of the internal

female genitalia also indicate that we have only one species, not two. California specimens of the species are the largest; a male from Alaska was the smallest specimen examined.

Gertsch is probably correct in stating that *Z. dispar* is distinct from *Z. montana* of Europe. Perhaps intermediates will be found in the vast area between Europe and Siberia from which no collections have been examined, but I would not expect this.

Diagnosis. Females of *Z. dispar* differ from those of the related *Z. montana* in that the median depression of the epigynum has a constriction (Figures 35, 39) in posterior view. The palpus is similar to that of *Z. montana* but differs in that most sclerotized parts of the palpus have a different shape and are positioned slightly differently (Figures 41, 42).

Natural history. The species is found on trees and rocks (Emerton, 1902, *The Common Spiders*, p. 185). Parts of the web have been illustrated by Emerton (1884, pl. 40, fig. 2). Emerton collected the species in the Adirondack Mountains, New York State, and the White Mountains, New Hampshire.

Distribution. Kamtchatka, Siberia, and North America along the Pacific coast, across Canada, the northern states, south in the western states, and in the Appalachian mountains in the east (Gertsch, 1964, fig. 1, a map).

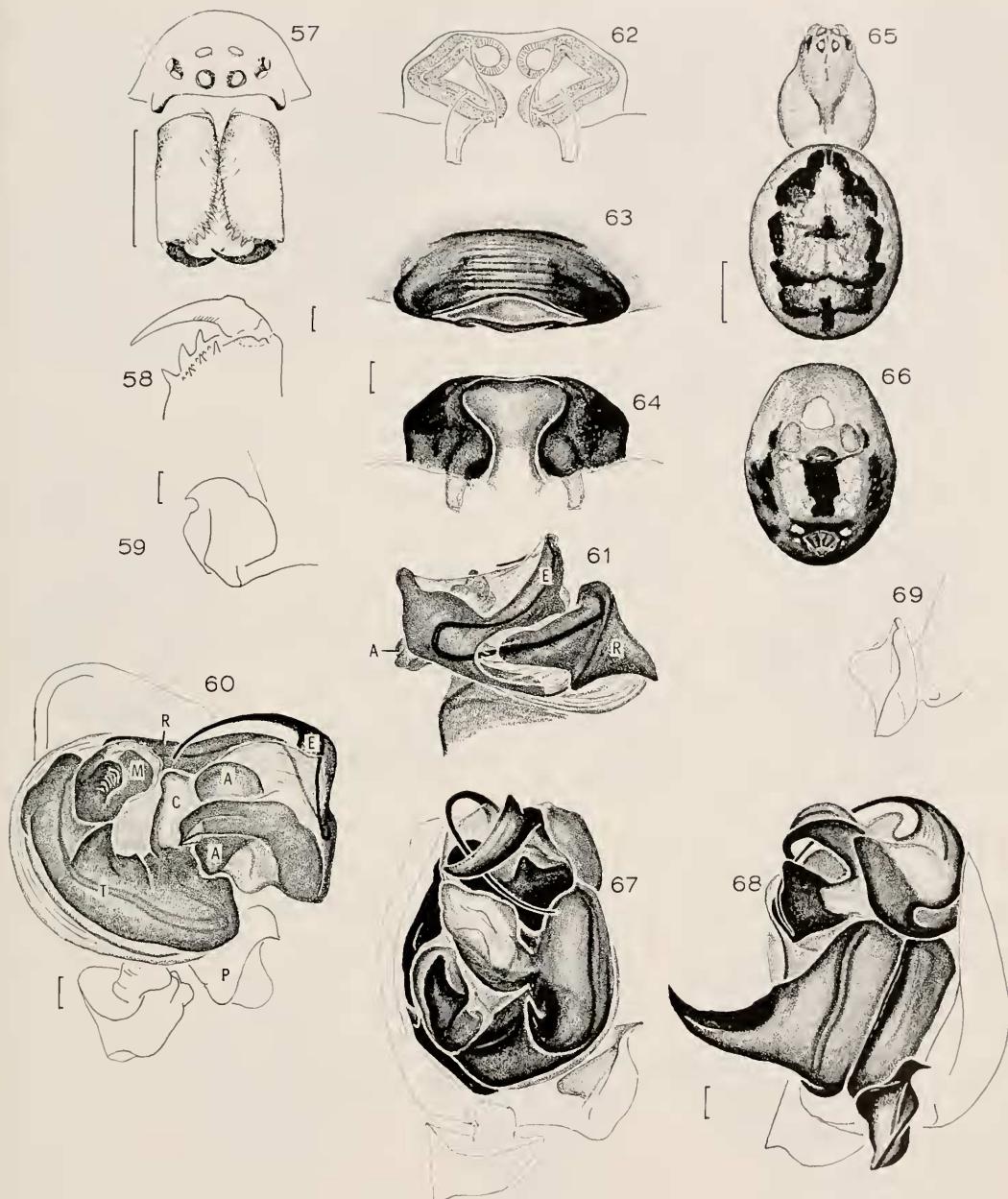
Zygiella montana (C. L. Koch)

Figures 51-56, 59-61

Zilla moutana C. L. Koch, 1839, *Die Arachniden*, 6: 146, pl. 536, 537, ♀, ♂. Syntypes probably from Nassfelder Alpen in Salzburg, Austria, in the Museum of the Humboldt University, Berlin, not examined. Wiegle, 1931, in Dahl, *Tierwelt Deutschlands*, 23: 38, figs. 46-48, ♀, ♂.

Zygiella montana, - Roewer, 1942, *Katalog der Araneae*, 1: 886. Bonnet, 1959, *Bibliographia Aranearium*, 2: 5003.

Description. Female from Seefeld, Tirol, Austria. Coloration as in other species.



Figures 57-58. *Zygiella x-notata* (Clerck). 57. Eye region and chelicerae. 58. Left chelicera from inside.

Figures 59-61. *Z. montana* (C. L. Koch). 59. Paracymbium dorsolateral view. 60-61. Left male palpus, expanded. 60. Subventral. 61. Dorsal, cymbium removed.

Figures 62-69. *Z. carpenteri* Archer. 62-64. Epigynum. 62. Posterior, cleared. 63. Ventral. 64. Posterior. 65. Female. 66. Female abdomen, ventral 67-69. Male palpus. 67. Ventral. 68. Lateral. 69. Paracymbium.

Abbreviations. A, terminal apophysis; C, conductor; E, embolus; M, median apophysis; P, paracymbium; R, radix; T, tegulum.

Scale lines. 0.1 mm, except Figures 57, 65, 66, 1.0 mm.

Secondary eyes 0.8 diameter of anterior medians. Anterior median eyes 0.7 diameter apart, 0.6 diameter from laterals. Posterior median eyes one diameter apart, 1.2 from laterals. Total length 8.0 mm. Carapace 2.9 mm long, 2.2 mm high. First femur, 3.0 mm; patella and tibia, 3.7 mm; metatarsus, 2.9 mm; tarsus, 1.2 mm. Second patella and tibia, 3.1 mm; third, 1.9 mm; fourth, 2.6 mm.

Male from Seefeld, Tirol, Austria. Secondary eyes 0.6 diameter of anterior medians. Anterior median eyes 0.6 diameter apart, 0.5 diameter from laterals. Posterior median eyes their diameter apart, 1.6 from laterals. Total length 6.5 mm. Carapace 3.0 mm long, 2.4 mm wide. First femur, 3.2 mm; patella and tibia, 5.0 mm; metatarsus, 4.3 mm; tarsus, 1.0 mm. Second patella and tibia, 3.9 mm; third, 2.3 mm; fourth, 3.2 mm.

Diagnosis. This European species can easily be confused with *Z. dispar* but the epigynum lacks the constriction of the median depression in posterior view (Figure 54; the palpus has many sclerites, all slightly different in shape (Figures 55, 56).

Natural history. According to Wiehle (1931) this is a mountain species found in the Alps above 1000 m elevation, most commonly between 1300–1800 m. The species is found on buildings, rocks, bark and branches of trees and shrubs. The web is similar to that of *Z. x-notata* with 19–35 radii. The vacant sector is especially wide and the hub has a rough structure.

Both sexes are mature from June until

September, and may take several years to mature.

Distribution. European mountains.

Zygiella carpenteri Archer

Figures 62–69

Zygiella carpenteri Archer, 1951, Amer. Mus. Novitates, No. 1487: 18, fig. 34, ♀. Female holotype from Del Monte Forest, Pacific Grove, Monterey Co., California, in the American Museum of Natural History, examined. Gertsch, 1964, Amer. Mus. Novitates, No. 2188: 9, figs. 1, 11–14, ♀, ♂, map.

Diagnosis. The wide depression of the epigynum (Figure 63), the long, pointed projection of the palpal tegulum (Figure 68) and the shape of the paracymbium (Figures 68, 69) separate the species from *Z. dispar*.

Distribution. Sierra mountains of Oregon and Washington. There are also a few records from near Spokane, Washington, and the coast of California. There is a distribution map in Gertsch (1964).

Zygiella caspica (Simon)

Figures 70–75

Zilla caspica Simon, 1889, Verh. zool. bot. Ges. Wien, 39: 382. Two female, one male syntypes from Transylvania in the Muséum National d'Histoire Naturelle, Paris, examined.

Zygiella caspica, - Roewer, 1942, Katalog der Aranidae, 1: 883. Bonnet, 1959, Bibliographia Aranearium, 2: 5002.

Description. Female. Color like that of other species. Legs not banded, yellowish brown. Dorsal pattern as is characteristic in *Zygiella* (Figure 70), venter with very

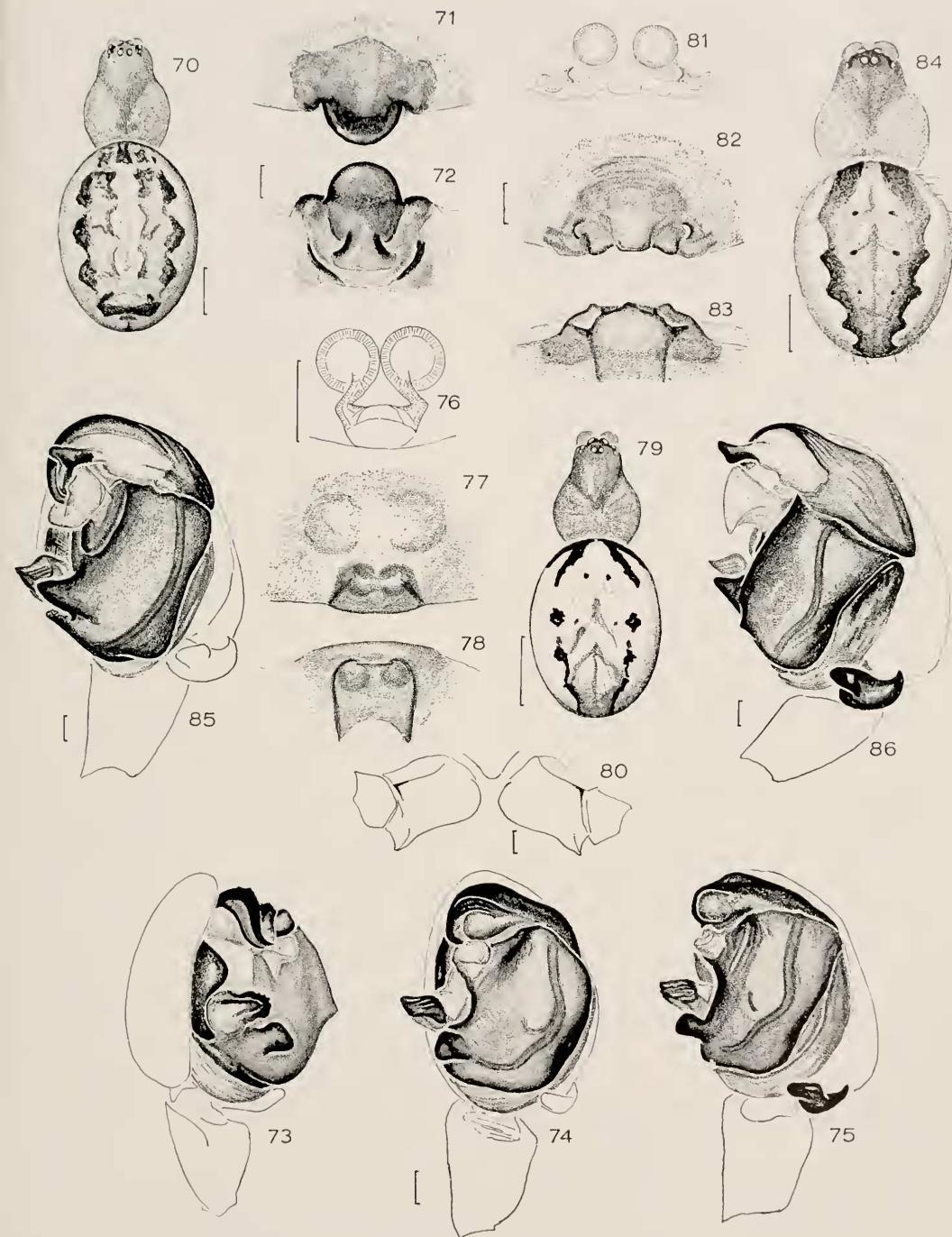
Figures 70–75. *Zygiella caspica* (Simon). 70. Female. 71, 72. Epigynum. 71. Ventral. 72. Posterior. 73–75. Left male palpus. 73. Mesal. 74. Ventral. 75. Lateral.

Figures 76–80. *Z. calyprata* (Workman). 76–78. Epigynum. 76. Dorsal, cleared. 77. Ventral. 78. Posterior. 79. Female. 80. Fourth coxae, ventral.

Figures 81–84. *Z. melanocrania* (Thorell). 81–83. Epigynum. 81. Ventral, cleared. 82. Ventral. 83. Posterior. 84. Female.

Figures 85–86. *Z. kochi* (Thorell), male palpus. 85. Ventral. 86. Lateral.

Scale lines. 0.1 mm except Figures 70, 79, 84, 1.0 mm.



little black pigment. The posterior median eyes are slightly smaller than anterior medians, laterals 0.8 diameter of anterior median eyes. The anterior median eyes are their radius apart, their radius from laterals. Posterior median eyes their diameter apart, and slightly more than one diameter from laterals. Total length 6.5 mm. Carapace 2.4 mm long, 1.9 mm wide. First femur, 2.8 mm; patella and tibia, 3.6 mm; metatarsus, 2.6 mm; tarsus, 0.9 mm. Second patella and tibia, 2.8 mm; third, 1.7 mm; fourth, 2.3 mm.

Male. Coloration as in female. The eyes are slightly larger and closer together. Total length 5.0 mm. Carapace 2.3 mm long, 1.7 mm wide. First femur, 2.9 mm; patella and tibia, 4.3 mm; metatarsus, 2.9 mm; tarsus, 1.2 mm. Second patella and tibia, 2.9 mm; third, 1.7 mm; fourth, 2.3 mm.

Diagnosis. While the short semicircular scape of the epigynum (Figures 71, 72) is distinct, the palpus is similar to that of *Z. kochi*, but differs in the shape of the tegulum at the base of the conductor and the terminal apophysis (Figures 73-75).

Distribution. Trans-Carpathian region.

Zygiella calyprata (Workman)

Figures 76-80

Epeira calyprata Workman, 1894, Malaysian Spiders, p. 21, plate 21. One female lectotype here designated and two female paralectotypes from Singapore in the National Museum of Ireland, Dublin, examined.

Epeira (Zilla) calyprata, - Thorell, 1895, Descri. Catalogue of the Spiders of Burma, p. 188.

Zygiella calyprata, - Roewer, 1942, Katalog der Araneae, 1: 886.

Araneus calypratus, - Bonnet, 1955, Bibliographia Aranearium, 2: 450.

Description. Female lectotype. Carapace brown; head region very much darker, glossy. Sternum, legs brown. Dorsum of abdomen white with black marks (Figure 79). Sides brownish black. Venter gray. Anterior median eyes much larger than others. Diameter of posterior median eyes 0.8 diameter of anterior medians; laterals

0.6 diameter of anterior median eyes. Anterior median eyes their diameter apart, slightly more than their diameter from laterals. Posterior median eyes slightly less than their radius apart, 2.5 diameters from laterals. The fourth coxa has a posterior distal spine (Figure 80). Total length 4 mm. Carapace 1.7 mm long, 1.3 mm wide. First femur, 1.5 mm; patella and tibia, 2.0 mm; metatarsus, 1.5 mm; tarsus, 0.6 mm. Second patella and tibia, 1.7 mm; third, 1.0 mm; fourth, 1.5 mm.

Diagnosis. Unlike females of *Z. melanocrania*, those of *Z. calyprata* have the median area of the epigynum dark with an indistinct border (Figure 77). It is doubtful that this species belongs to *Zygiella* and is related to the other *Zygiella* species.

Distribution. Malaysia, Burma. (Of Thorell's specimens labeled *Epeira calyprata* in the British Museum, Natural History, one is this species, the other specimen is a related species.)

Zygiella melanocrania (Thorell)

Figures 81- 84

Epeira melanocrania Thorell, 1887, Ann. Mus. Civica Storia Natur. Genova, (2)5: 209. Female holotype from Teinzo, Burma, in the Museo Civico di Storia Naturale, Genova, examined.

Zygiella melanocrania, - Roewer, 1942, Katalog der Araneac, 1: 886.

Araneus melanocranius, - Bonnet, 1955, Bibliographia Aranearium, 2: 543.

Description. Carapace shiny brown. Head region dark brown. Chelicerae brown, darker than head region. Sternum yellow-brown. Legs brown, first two darker than last two, with faint indications of darker rings. Dorsum of abdomen with characteristic black and white *Zygiella* pattern (Figure 84). Venter with white pigment spots only. Secondary eyes 0.8 diameter from anterior median eyes. Anterior median eyes are a diameter apart, slightly more than one diameter from laterals. Posterior median eyes are their radius apart, 2.5 diameters from laterals. The laterals are separated by their radius from each

other. The height of the clypeus is about equal to the radius of the anterior median eyes. The chelicerae of one specimen have four teeth on the anterior margin of the fang furrow, but the posterior margin has four on one chelicera, three on the other; there are denticles in the furrow. The abdomen is oval and hairy. Total length 5.5 mm. Carapace 2.6 mm long, 2.0 mm wide. First femur, 2.7 mm; patella and tibia, 3.3 mm; metatarsus, 2.1 mm; tarsus, 0.9 mm. Second patella and tibia, 2.7 mm; third, 1.6 mm; fourth, 2.2 mm.

Diagnosis. The epigynum (Figures 82, 83), with two semicircular openings on the ventral side, separates this species from all other known *Zygiella*.

Distribution. This species is known only from the type specimen. The specimen illustrated by Dyal (1935, Bull. Dept. Zool., Panjab Univ. 1: 183, pl. 16, fig. 125) is probably not this species.

Zygiella kochi (Thorell)

Figures 85-91

Zilla kochii Thorell, 1870, Remarks on Synonyms of European Spiders, p. 33. Syntypes from Nice and Monaco presumably in the Stockholm Natural History Museum. Bösenberg, 1901, Zool. Anz., 13: 43, pl. 3, fig. 32, ♀, ♂. Wiehle, 1929, Z. Morphol. Ökol. Tiere, 15: 262-308. Wiehle, 1931, in Dahl, Tierwelt Deutschlands, 23: 41, figs. 52, 53, ♀, ♂.

Zygiella kochi, - Simon, 1929, Arachnides de France, 6(3): 663, 754, figs. 1021, 1025, ♀, ♂. Roewer, 1942, Katalog der Araneae, 1: 884. Bonnet, 1959, Bibliographia Araneorum, 2: 5002.

Description. Female from France. Carapace brown, with darker lines going from eye region to thoracic depression (Figure 87). Sternum brown. Legs very indistinctly banded. Dorsum of abdomen with usual pattern (Figure 87). Venter with a black spot framed by white on each side. Secondary eyes 0.7 diameter of anterior medians. Anterior median eyes 0.7 diameter apart, one diameter from laterals. Posterior median eyes one diameter apart, a little less than two diameters from laterals.

Total length 7.5 mm. Carapace 3.5 mm long, 2.5 mm wide. First femur, 3.2 mm; patella and tibia, 4.3 mm; metatarsus, 3.0 mm; tarsus, 1.3 mm. Second patella and tibia, 3.2 mm; third, 2.0 mm; fourth, 2.9 mm. The entrance into the seminal receptacles is through pockets and folds rather than through distinct ducts (Figures 88, 91).

Description of male from unknown locality. Posterior median eye diameter about the radius of anterior median eyes; anterior lateral eyes 0.7 diameter of anterior median eyes; posterior lateral eye diameter about the radius of anterior median eyes. Anterior median eyes their radius apart and about their radius from laterals. Posterior median eyes their diameter apart, 1.5 diameters from laterals. There are no modifications on appendages. Total length 7 mm. Carapace 3.1 mm long, 2.3 mm wide. First femur, 3.2 mm; patella and tibia, 4.7 mm; metatarsus, 3.1 mm; tarsus, 1.3 mm. Second patella and tibia, 3.6 mm; third, 2.0 mm; fourth, 2.6 mm.

Diagnosis. The heart-shaped scape of the epigynum (Figure 89) separates this species readily from others. The scape has a central depression. The rim on the tegulum surrounding the base of the conductor, and the shape of the subterminal apophysis of the palpus separate males from *Z. caspica* (Figures 85, 86).

Natural history. The species is found on trunks of trees, cork bark and chestnut in Corsica; its retreat is in cracks in bark (Wiehle, 1929, 1931). The web is similar to that of *Z. x-notata*; of fifteen webs four did not have the vacant sector but had complete orbs (Wiehle, 1929).

Distribution. Central and southern Europe, Mediterranean region and North Africa (Bonnet, 1959).

Zygiella inconveniens (O.P.-Cambridge)

Figures 92-94

Epeira inconveniens (O.P.-Cambridge), 1872, Proc. Zool. Soc. London, p. 298. Female holotype.

type and juvenile lectotype from Beirut, Lebanon.

Zygiella inconveniens, - Roewer, 1942, *Katalog der Araneae*, 1: 883.

Araeus inconveniens, - Bonnet, 1955, *Bibliographia Aranearium*, 2: 522.

Description. Coloration characteristic for the genus (Figure 92). The secondary eyes are about 0.8 diameter of anterior medians. Anterior median eyes are 0.7 diameter apart, their radius from laterals. The posterior median eyes are slightly less than one diameter apart, slightly more than one from laterals. Total length 5.5 mm. Carapace 2.5 mm long, 1.9 mm wide. First femur, 2.3 mm; patella and tibia, 3.2 mm; metatarsus, 2.4 mm; tarsus, 0.9 mm. Second patella and tibia, 2.5 mm; third, 1.5 mm; fourth, 2.2 mm.

Diagnosis. Females differ from *Z. kochi* in the longer, narrower scape of the epigynum (Figure 93).

Distribution. Only known from Beirut, Lebanon.

Zygiella thorelli (Ausserer)

Figures 95-101

Zilla thorelli Ausserer, 1871, *Verhandl. zool. bot. Ges. Wien*, 21: 830, pl. 5, fig. 10, ♀. Female from Prater (amusement park), Vienna, Austria, probably in the Naturhistorisches Museum, Wien, not examined. Wiegle, 1931, *in Dahl, Tierwelt Deutschlands*, 23: 39, figs. 49-51, ♀, ♂.

Zygiella thorelli, - Simon, 1929, *Arachnides de France*, 6(3): 663, 664, 755, figs. 1019, 1024, ♀ ♂. Roewer, 1942, *Katalog der Araneae*, 1: 884. Bonnet, 1959, *Bibliographia Aranearium*, 2: 5006.

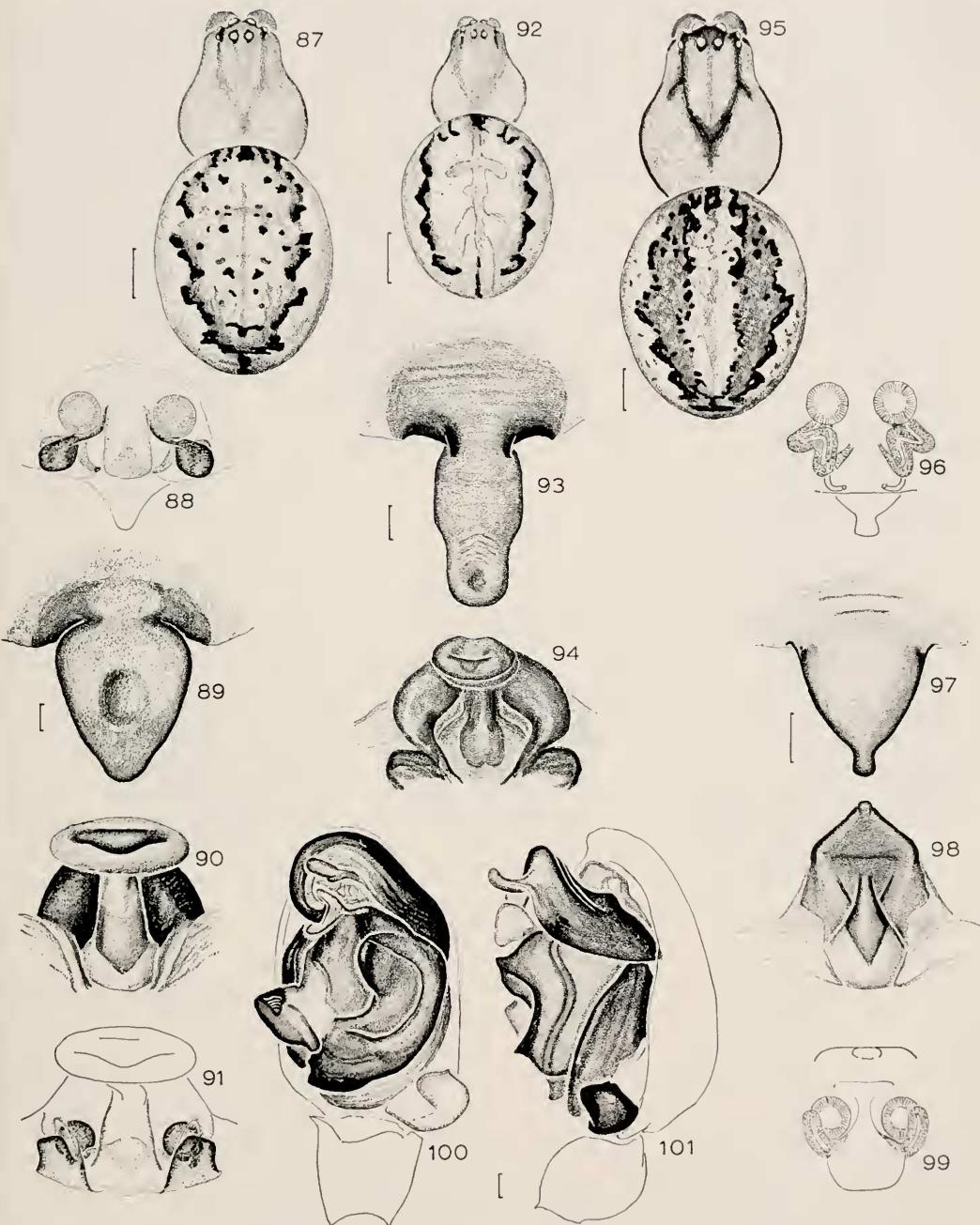
Description. Female from France. Carapace brown, black lines from each posterior lateral eye to thoracic region, fusing there with a lateral branch; black line around margin of the thoracic region (Figure 95). Chelicerae dark brown. Sternum dark brown with light brown median longitudinal narrow band. Legs brown with narrow dark bands. Dorsum with characteristic pattern (Figure 95) containing black and with white pigment spots. Ven-

ter black between genital furrow and spinnerets, with a white line on each side. Posterior median eyes 0.6 diameter of anterior median eyes. Anterior lateral eyes 0.7 diameter of anterior medians, posterior lateral eyes 0.5 diameter of anterior median eyes. Anterior median eyes 0.7 diameter apart, one diameter from laterals. Posterior median eyes slightly less than their diameter apart, 1.7 from laterals. On the anterior margin of the fang furrow, the chelicerae have three large teeth; on the posterior margin, four teeth and, farthest from fang, a denticle. Total length 10 mm. Carapace 4.5 mm long, 3.2 mm wide. First femur, 4.9 mm; patella and tibia, 6.7 mm; metatarsus, 5.0 mm; tarsus, 1.7 mm. Second patella and tibia, 5.0 mm; third, 2.9 mm; fourth, 4.0 mm.

Male from Kochem on the Mosel, Germany. Coloration like that of female. Secondary eye diameter 0.6 diameter of anterior median eyes. Anterior median eyes slightly less than their radius apart, their diameter from laterals. Posterior median eyes 0.7 diameter apart, 1.5 diameters from laterals. The chelicerae have three teeth on the anterior margin; three smaller teeth on the posterior. Total length 7.5 mm. Carapace 3.9 mm long, 2.8 mm wide. First femur, 4.8 mm; patella and tibia, 7.0 mm; metatarsus, 6.5 mm; tarsus, 1.8 mm. Second patella and tibia, 5.0 mm; third, 2.8 mm; fourth, 3.5 mm.

Diagnosis. This species has a longer, narrower carapace than is seen in other species of *Zygiella*. Females are distinct in the shape of the epigynal scape, a lobe with a distal extension (Figure 97). Males are characterized by the sculptured, human-ear-shaped tegulum (Figure 100). No other known species is close to *Z. thorelli*.

Natural history. This central European species prefers warm locations such as walls of ruins and cliffs. It has also been found on wooden buildings. The sexes are mature in August and September (Wiegle, 1931). The web, a typical *Zygiella* web,



Figures 87–91. *Zygiella kochi* (Thorell). 87. Female. 88–91. Epigynum. 88. Dorsal, cleared. 89. Ventral. 90. Posterior. 91. Posterior, cleared.

Figures 92–94. *Z. inconveniens* (O. P.-Cambridge). 92. Female. 93, 94. Epigynum. 93. Ventral. 94. Posterior.

Figures 95–101. *Z. thorelli* (Ausserer). 95. Female. 96–99. Epigynum. 96. Dorsal, cleared. 97. Ventral. 98. Posterior. 99. Posterior, cleared. 100, 101. Left male palpus. 100. Ventral. 101. Lateral.

Scale lines. 0.1 mm except Figures 87, 92, 95, 1.0 mm.

is pictured in Lendl (1891, *Potpüz Termész. közl.*, Budapest, 13: 31, figure 8).

Distribution. France, southern Germany, Czechoslovakia, Poland to Italy and Roumania (Bonnet, 1959).

Zygiella stroemi (Thorell)

Figures 102-110

Zilla stroemi Thorell, 1870, Remarks on Synonyms of European Spiders, p. 235. New name for *Zilla montana*, Westring (not C. L. Koch) from Sweden. Wiegle, 1931, in Dahl, Tierwelt Deutschlands, 23: 36, figs. 43-45, ♀, ♂.

Zygiella x-notata, - Roewer, 1942, Katalog der Araneae, 1: 884 (not *x-notata* Clerck).

Zygiella stroemi, - Locket and Millidge, 1953, British Spiders, 2: 163, figs. 108b, 109c, ♀, ♂. Bonnet, 1959, Bibliographia Aranearium, 2: 5005.

Description. Female from Plitvice, Croatia, Jugoslavia. Coloration similar to that of other species (Figure 103). Diameter of posterior median eyes 0.8 diameter of anterior medians. Anterior lateral eyes 0.9 diameter of anterior medians and posterior lateral eyes 0.8 diameter of anterior medians. Anterior median eyes slightly less than their radius apart, the same distance from laterals. Posterior median eyes their diameter apart, slightly more than their diameter from laterals. Total length 4.5 mm. Carapace 1.9 mm long, 1.5 mm wide. First femur, 2.2 mm; patella and tibia, 2.7 mm; metatarsus, 2.0 mm; tarsus, 0.9 mm. Second patella and tibia, 1.9 mm; third, 1.3 mm; fourth, 1.9 mm.

Male from Plitvice, Croatia, Jugoslavia. Diameter of secondary eyes 0.7 diameter of anterior medians. Anterior medians 0.3 diameter apart, the same distance from laterals. Posterior median eyes slightly less than their diameter apart, slightly more than their diameter from laterals. Total length 3.4 mm. Carapace 1.7 mm long, 1.6 mm wide. First femur, 2.2 mm; patella and tibia, 3.0 mm; metatarsus, 2.6 mm; tarsus, 1.0 mm. Second patella and tibia, 2.2 mm; third, 1.1 mm; fourth, 1.5 mm.

Diagnosis. The flat, long seape with almost parallel sides (Figure 104) separates

females from all other *Zygiella*. Males are distinguished by the truncate projection of the tegulum of the palpus (Figures 108-110).

Natural history. The web is on the trunks of pines (Wiegle, 1931; Locket and Millidge, 1953); the retreat is under bark. Wiegle (1931) reports that the species matures from May until June, and several specimens may be found near each other.

Distribution. Most of Europe to Siberia and Turkestan (Bonnet, 1959).

Zygiella sia (Strand)

Figures 111-120

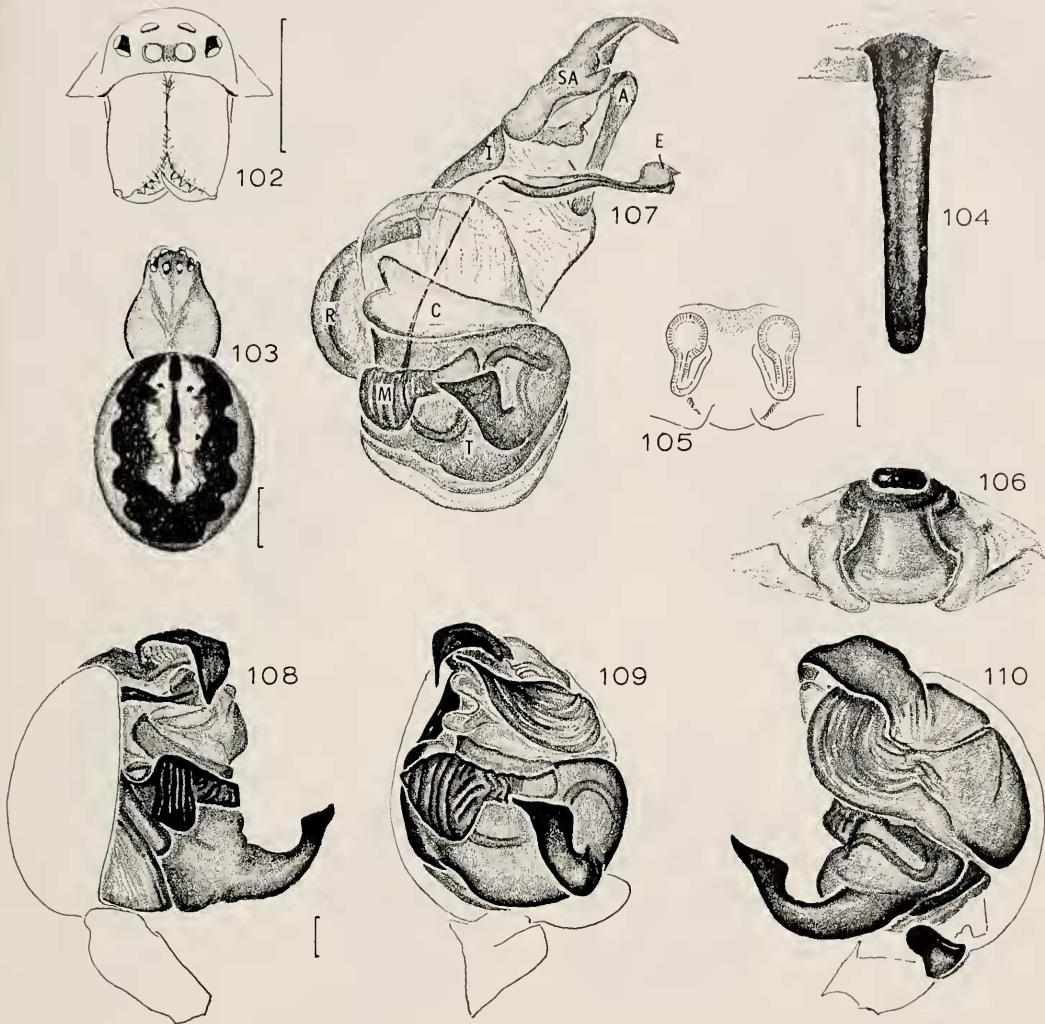
Aranea (*Zilla*) *sia* Strand, 1906, in Bösenberg and Strand, Abhandl. Senckenberg. Ges., 30 (1-2): 237, pl. 4, fig. 24, ♂. Adult female, male, and 5 juvenile syntypes from Japan in the Senckenberg Museum, Frankfurt, examined.

Zygiella sia, - Roewer, 1942, Katalog der Araneac, 1: 884.

Aranen *sia*, - Bonnet, 1955, Bibliographia Aranearium, 2: 598. Yaginuma, 1960. Spiders of Japan in Colour, Osaka, p. 54, figs. 1, 3, plate 19, fig. 115, ♀, ♂.

Zilla sia, - Saito, 1959, The Spider Book Illustrated in Colours, Tokyo, p. 109, fig. 23, pl. 17, fig. 129 a, b, pl. 18, fig. 129 d, ♀, web.

Description. Female syntype. Carapace brown, head region darker brown, darker area coming to a point posteriorly in thoracic depression. Some white hairs on sides. Sternum dark brown. Legs indistinctly to distinctly banded. Abdomen with the characteristic pattern. Venter with a white longitudinal line on each side. Posterior median eyes 0.6 diameter of anterior medians, anterior lateral eyes 0.6, posterior laterals 0.5 diameter. Anterior median eyes 0.8 diameter apart, 1.5 diameters from laterals. Posterior median eyes 0.7 diameter apart, 3.0 diameters from laterals. Lateral eyes slightly separated. There are three teeth on the anterior margin of chelicerae. Total length 7 mm. Carapace 2.7 mm long, 2.2 mm wide. First femur, 2.9 mm; patella and tibia, 4.0 mm; metatarsus, 2.7 mm; tarsus, 0.7 mm. Second patella and tibia, 3.4 mm; third, 1.9 mm; fourth, 2.7 mm.



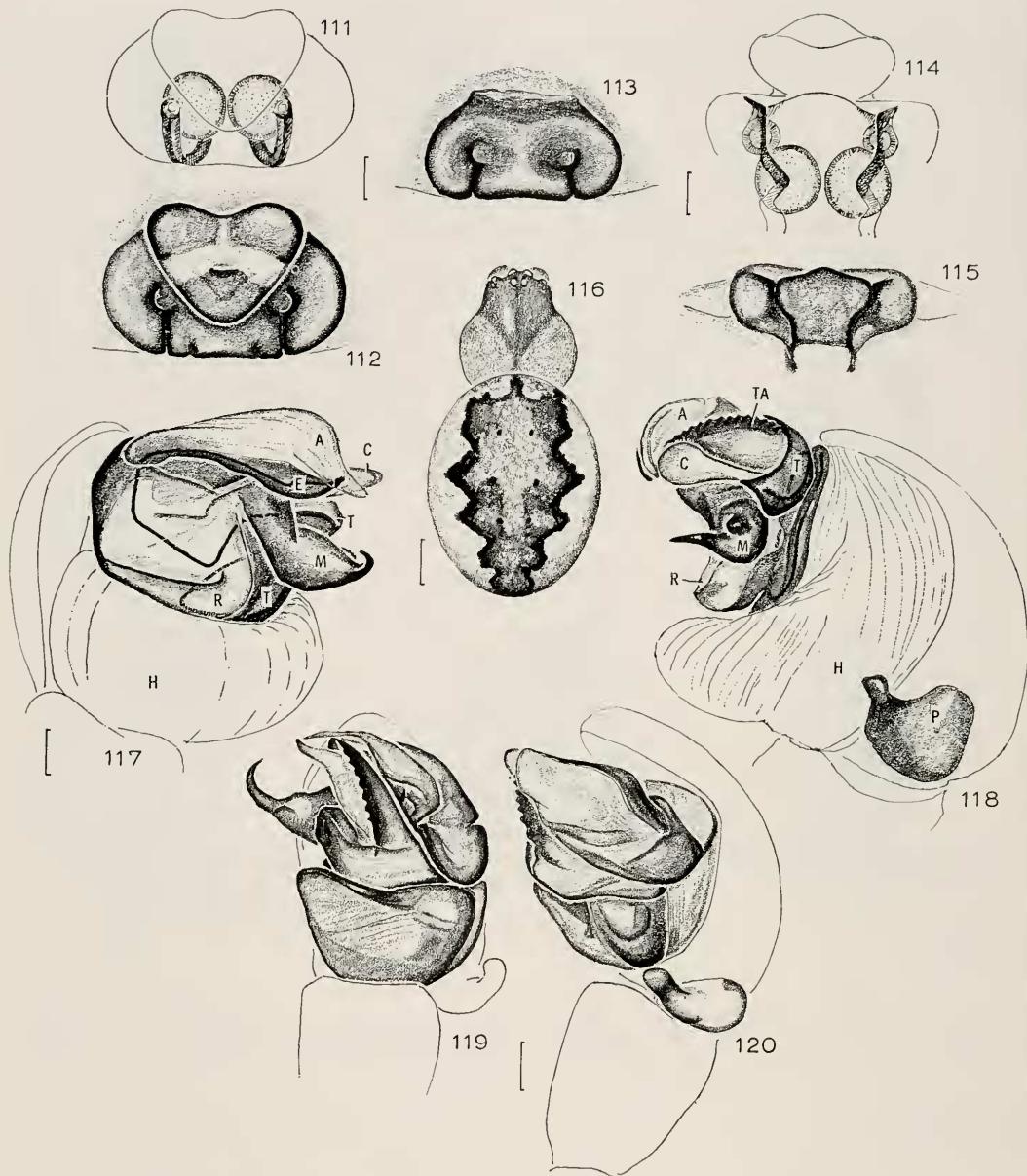
Figures 102-110. *Zygella stroemi* (Thorell). 102. Eye region and chelicerae. 103. Female. 104-106. Epigynum. 104. Ventral. 105. Anterodorsal, cleared. 106. Posterior. 107-110. Left male palpus. 107. Expanded. 108. Mesal. 109. Ventral. 110. Lateral.

Abbreviations. A, terminal apophysis; C, conductor; E, embolus; I, stipes; M, median apophysis; R, radix; SA, subterminal apophysis; T, tegulum.

Scale lines. 0.1 mm except Figures 102, 103, 1.0 mm.

Male syntype from Japan. Coloration as in female, but abdominal pattern more distinct. Diameter of secondary eyes about equal to radius of anterior medians. Posterior lateral eyes slightly smaller than other secondary eyes. Anterior median eyes 0.7 diameter apart, one diameter from

laterals. Posterior median eyes 0.6 diameter apart, three diameters from laterals. There are three teeth anteriorly on cheliceral fang margin and three posteriorly. Total length 6 mm. Carapace 2.6 mm long, 2.1 mm wide. First femur, 3.0 mm; patella and tibia, 4.1 mm; metatarsus, 2.9



Figures 111-120. *Zygiella sia* (Strand). 111-115. Epigynum. 111. Ventral, cleared. 112. Ventral. 113. Ventral, scape torn off. 114. Posterior, cleared. 115. Posterior. 116. Female. 117-120. Left male palpus. 117, 118. Expanded. 119. Ventral. 120. Lateral.

Abbreviations. A, terminal apophysis; C, conductor; E, embolus; H, hematodocha; M, median apophysis; P, para-cymbium; R, radix; T, tegulum; TA, projection of tegulum.

Scale lines. 0.1 mm except Figure 116, 1.0 mm.

mm; tarsus, 1.0 mm. Second patella and tibia, 3.3 mm; third, 1.8 mm; fourth, 2.6 mm.

Note on size. Several other specimens of this species were examined. They were much larger. And with the size increase there was a proportionate increase in the *distance* of the laterals from the median eyes. A female from Shiga Prefecture was 12.5 mm total length. The specimen had a carapace 4.7 mm long and 4.1 mm wide, about 1.7 times the size of the female syntype. The legs were of proportionate length, 1.7 times that of the syntype. The comparative eye sizes stayed the same but anterior median eyes were about twice their diameter from laterals (a *distance* increase of about 1.3 times) and the posterior medians slightly less than five times from laterals (a *distance* increase of 1.6 times almost proportionate to growth). The eyes thus grew relatively less.

Male specimens from Naga Prefecture were also larger: total length 7.5 and 10.5 mm; carapace 3.8 and 5.1 mm long, 2.7 and 3.9 mm wide. These measurements are 1.4 times and 2.0 times the corresponding measurements of the syntype; the appendage articles were, however, 1.7 times and 2.2 times the length of the carapace of the type. Growth of males' legs thus did not seem proportional. However, in the two different-sized males from Naga Prefecture, carapace and leg sizes were in proportion.

The Naga males had the diameter of the secondary eyes 0.7 diameter of the medians (the syntypes about 0.5 diameter). The syntype had the anterior median eyes one diameter from laterals, the smaller Naga specimen one and one-half, the larger one slightly less than two. The posterior median eyes were three diameters from laterals in the syntype, about four in the smaller Naga specimen (1.3 times the distance), about five times in the larger one (1.7 times the distance in the syntype). The eye distances increase less than size; there

appears to be only little increase in eye sizes.

Presumably the specimens had matured in different instars. But these proportional differences seem surprising considering the similarity in proportion and size of the epigyna and male palpi.

The male specimen whose carapace was twice as long as the carapace of the syntype, also had the palpal tibia 2.5 times as long as that of the syntype (a proportional increase with leg length), but the critical palpal cymbium was only 1.4 times longer than that of the syntype. The larger specimen thus had relatively a much longer palpal tibia. No differences were noted in the position and proportion of the sclerites held within the cymbium.

Diagnosis. The heart-shaped scape covering the ventral openings of the epigynum (Figure 112) separates the female from all other *Zygiella*. The scape has a transverse light mark. The male palpus (Figures 119-120) is superficially very different from other species: it has a huge basal hematochoda, a minute tegulum bearing a toothed projection, and the median apophysis has a projecting hook (Figures 117-118). As in *Z. atrica* the palpal tibia is slightly elongated, but of a different shape.

There is some doubt in placing this species in *Zygiella*, because of the wider spacing of the eyes and the cap on the palpal embolus in the expanded palpus (Figure 117), not otherwise seen in the genus. The course of the duct into and through the tegulum remains uncertain, despite its having been illustrated in Figures 117, 118.

Distribution. Japan. Fox (1938, J. Washington Acad. Sci. 28: 367) reported specimens from Szechwan Prov. China, but the specimens of the U.S. National Museum could not be found.

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